Zero Retries issue 0003 2021-07-30

Advanced Amateur Radio - Data Communications; Space; Microwave… the fun stuff!
Nothing great has ever been accomplished without irrational exuberance. - Tom Evslin.

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fsq is a Gateway Drug for Building a Radio Community

I credit Chris Doutre KC9AD for the phrase *fsq is a Gateway Drug*. He's absolutely right. In Zero Retries Issue 0001 I mentioned the group of fsq users here in Whatcom County:

> A more current example is the use of 145.58 MHz as the "fsq water hole" here in Whatcom County (Bellingham), Washington. 145.58 MHz is the chosen frequency for operating with the fsq mode (one of the many modes in the fldigi suite). Although fsq was designed for HF use, it's remarkably robust when used on FM. Its ability to decode data despite a noisy simplex signal is why it was chosen as an effective mode for casual keyboard chat within Whatcom County even using simplex. Another factor was that it was open source, and had been implemented into a Linux version that runs well on the Raspberry Pi series of computers. When I relocated to Whatcom County two years ago, it was easy for me to just be "part of the crowd" by tuning into 145.58 and participating with the other stations that are parked on 145.58, and especially the fsq chat net every Sunday morning at 09:00.

I'll amplify on the above a bit and discuss using fsq to begin a community. Why fsq?

- fsq is a robust mode that survives a lot of abuse and low signal-to-noise ratio (SNR), and is well-suited to conducting a chat amongst peers with no infrastructure required - only a simplex channel. Part of the reason it's robust is that it uses slow data rates; the

maximum transfer rate is six characters per second, which sounds slow, but it's adequate for chatting within a group.

- fldigi is a mature, capable, open source implementation of unique, robust data modes. It has been ported to Windows, Mac, and Linux, including Linux that runs on the Raspberry Pi computers.

- fsq doesn't require much of an audio interface to work. One of the easiest audio interfaces to use for fsq, and most other "sound card modes" is the venerable Tigertronics SignaLink USB. The SignaLink USB is well-supported by Tigertronics, and Tigertronics sells a variety of cables and preconfigured internal jumpers (PDF) for easy connection to most radios.

- fsq is fully capable of functioning with radios as simple as an inexpensive portable radios (though you'll probably have to use an external antenna to connect with other stations).

- fldigi has good documentation (*excellent* documentation for an open source project).

You'll probably be asking… why can't we put all our old TNCs to use creating a on-air community / water hole? You could, and there are many, many "community" systems for packet radio, such as Bulletin Board Systems (BBS'), digipeater capability, networking systems, etc. The reason I was given for using fsq in Whatcom County was that fsq was just way easier, and way more robust, for casual keyboard chatting. After being part of that community for months now, I concur with that assessment.

As for the "Gateway Drug" aspect… once you have formed a community that is interested in data modes, some of them will be interested to try other data modes, such as getting Packet Radio running (using the same computer and same audio interface as fsq) using Dire Wolf (also open source / available on Windows, Mac, and Linux). Windows users (only) can try getting VARA FM running; Zero Retries Issue 0004 will be a deep dive on VARA FM.

If the above resonates with you, and you're near **Anthem, Arizona (metro Phoenix)**, KC9AD would like to chat with you on 145.670 MHz using fsq.

KC9AD also clued me in to the City of Richardson, Texas Radio Amateur Civil Emergency Service (Richardson RACES) group (Dallas metro area) that is active on 145.670 MHz with fsq. Note their effective use of the groups.io minimal web page to explain their group, and frequencies.

I'm sure there are other "fsq water holes" - feel free to let me know about them.

Informational Web Pages

Here are a few web pages that are purely informational that I think fit the Zero Retries ethos.

73 Magazine Archive on Internet Archive - Every issue of 73, all 43 years of it, 1960-10 through 2003-09 was digitized and is now available for reading or download on the Internet Archive. Steve Lampereur KB9MWR described his index to 73 - **73 Magazine Information**

well with an apt tagline - *A rather insane project*… Thanks to KB9MWR, those of us wanting to find something specific within those 43 years of issues, and "… over 64,000 pages" can quickly locate articles of interest. I did a quick "search on page" for "packet radio" and found 16 matches. For "packet", there were 96 matches including this gem of an article in the December 1978 (#219) issue - The Packet Radio Revolution - pioneers, take note! ..... by Robert Rouleau VE2PY on page 192. (Of course, after writing the preceding sentence, I had to go look. Use the scrollbar at the bottom to quickly advance to page 192.) This is a very early article describing the first use of Packet Radio by the Montreal, Quebec Montreal Amateur Radio Club - the dawn of Amateur Radio's use of Packet Radio technology!

ARRL Gateway Newsletter (partial) - Gateway and the TAPR Packet Status Register (PSR) Newsletter (see below) was the "glue" that tied all the evolving Packet Radio users, experiments, groups, and vendors together. Gateway was biweekly (?) and brief, and the PSR was quarterly and deep. The combination of the two really helped you understand how to do Packet Radio and how it was evolving.

Hackaday.com (Radio Hacks) - I love Hackaday because they treat Amateur Radio, especially data modes and projects (like New Packet Radio), as interesting wireless experimentation for techies. It's particularly valuable that Hackaday is good content that's easily found (not hidden behind a paywall like what the Amateur Radio Publishing-Industrial Complex does with their content). Hackaday makes Amateur Radio look cool to techies, which we *desperately* need.

Ham Radio Horizons Archive on World Radio History - Every issue of Ham Radio Horizons, all 4 years of it, 1977-01 through 1980-12 was digitized and is now available for reading or download on World Radio History. Ham Radio Horizons was a predecessor of ARRL's "Now You're Talking" magazine in providing focused content for new Amateur Radio Operators. HRH taught me a lot about Amateur Radio in my early years, even before I obtained my Amateur Radio license. One example of how useful it is to have online access to articles such as HRH is **The G5RV Antenna** on page 36 of the June, 1977 Issue. The G5RV is a classic highly useful multi-band HF antenna that hasn't changed much in the decades since it was developed. Thus this article written for an audience of new Amateur Radio Operators, is still useful. Once there is an online index of HRH, a brief web search would find this article.

Mac Ham Radio - Apple computers are often thought of as lagging behind Windows and Linux when it comes to Amateur Radio software, but there is a wealth of top quality applications available for MacOS and IOS for just about every Amateur Radio operator. This site is a good reference for using Macs and IOS devices in Amateur Radio. Kudos to Steve Goldsmith W1HS as the current curator for this repository, as well as his predecessors.

Packet-radio.net - A good reference site for Packet Radio technology. It's good that there are others even more deeply into Packet Radio than I am.

RepeaterBook - In my experience this is the best directory of repeaters. Its data is crowdsourced, not derived from other databases or organizations. I've used the RepeaterBook IOS app extensively, and it works very well to find repeaters in an area using the device's onboard location systems.

RTL-SDR.com - A great reference site on all the inexpensive RTL-SDR type Software Defined Receiver dongles. No points off for favoring the ones they manufacture because they're far

superior to the units that are a few dollars cheaper from knockoff vendors.

Signal Identification Guide - An open sourced (Wiki) compendium of various modulation types. When you receive a signal that you've never seen before, look it up here.

Signals Everywhere - A good reference site on using Software Defined Transceivers.

TAPR Packet Status Register Newsletter - All issues, 1982 to present.

University of Arkansas at Little Rock Amateur Radio Club Call Sign Database - This is my goto for looking up US Amateur Radio callsigns (and to search on names to find a callsign). This is my favorite callsign reference there's no cruft to it - no ads, no need to log in with an account, etc. - it's just elegantly simple.

Bob Bruninga WB4APR - WB4APR is best known as the creator of Automatic Packet Reporting System (APRS). Bob's interests extend considerably beyond "simple" APRS, and this index page shows his breadth of interests.

Amateur Radio in Orbit - OSCAR 0

With this issue, I'll begin a section in each issue of something "Zero Retries interesting" about Amateur Radio activities in space. (Issue 0004 next week will be an exception - the Substack editor software informs me that issue is maxed out.

Sputnik
I was going to call this section "Sputnik" in honor of humanity's first artificial satellite launched in 1957, but after staring at it for a week, it just didn't work. There were three Sputnik satellites, but only the first one is well known. Although Sputnik didn't transmit on frequencies allocated to Amateur Radio (20.005 MHz and 40.002 MHz), those frequencies are close enough to Amatur Radio bands that Amateur Radio operators in 1957 were easily able to receive the transmissions. Prior to researching this section, I had the impression that Sputnik transmitted Morse Code, but apparently Sputnik 1 transmitted a continuous carrier which alternated between the two frequencies, with some very simple signaling of a few internal conditions.

OSCAR 0
There is a "communications satellite" that's older than Sputnik, and it's been in Earth orbit for 4.53 billion years - our beloved orbital companion, Luna. Amateur Radio Operators who've been active for a long time eventually hear Luna referred to as "OSCAR 0" because Amateur Radio Operators *can use Luna as a communications satellite* to relay communications between two (or more) points on Earth. Amateur Radio Operators call such communications "Moonbounce" (catchy, eh?) or more acronym'y Earth-Moon-Earth (EME). EME was first done by the US Army during Project Diana in 1946.

In the 20th century an Amateur Radio EME station consisted of a cluster of directional antennas (or a dish, if you used microwave frequencies), powerful transmissions (a good use of an Amateur Radio operator's ability to use transmit power up to 1,000 watts), sensitive receivers, and a very simple modulation method such as Morse Code. It was quite an accomplishment to do EME "back in the day" because you had to assemble quite the

combination of specialized equipment and make it all work together.

Sometimes it was a bit easier to work EME on rare occasions when the (late) Arecibo Radio Telescope (and similar facilities) were used as an EME station. With its amazing dish, Arecibo could transmit very powerful signals to Luna, and receive the very weak echoes from Luna very well. Thus a modest Amateur Radio station such as a single 11-element beam on 440 MHz, with transmit power of 100 watts, and a modest receive amplifier, *could* communicate with Arecibo because the signal gain of Arecibo's dish compensated for modest stations.

Fast forward to 2004 - Princeton University Professor (and 1993 Nobel Prize for Physics Laureate) Joe Taylor K1JT had some time on his hands. From his previous work with pulsars, K1JT knew "a little something" about writing sophisticated signal processing software, and had recently released his JT65 Mode software. Running on a typical desktop computer, JT65 software made it possible for modest stations to communicate via EME. In K1JT's June, 2005 article EME with JT65 (PDF), he explained:

> The JT65 transmission protocol uses state-of-the-art message encoding with powerful error-correcting features, coupled with highly efficient modulation based on a constant-envelope waveform and 65-tone frequency-shift keying. The combination is much more effective for EME than Morse code and on-off keying. Together with well optimized decoding algorithms, it enables JT65-equipped stations to make QSOs at signal levels some 10 to 15 dB below the minimum required for "ear and brain" CW communication. This huge advantage brings EME capability within reach of a much wider range of stations. Perhaps best of all, WSJT is designed to facilitate contacts between human operators, not between computers. The internet does the computer link so easily that we don't even pause to think about it; JT65 EME contacts, on the other hand, are thrilling and fun.

K1JT released JT65 as part of what is now an entire suite of weak signal modes as open source software. The WSJT (Weak Signal Joe Taylor) software has been ported to all major operating systems, and can run on computers as modest as a Raspberry Pi running Linux. It's not an overstatement that K1JT's contributions to Amateur Radio revolutionized data modes on Amateur Radio. Amateur Radio Operators can now routinely communicate with another station using signals so weak, with so much interference, that the other station cannot be heard by the human ear, but the WSJT software can "pull the signal from below the noise floor". I was privileged to meet J1JT briefly as one of the attendees at the 2018 MicroHAMS Digital Conference, where K1JT did a presentation on Work the World with WSJT-X.

While I consider JT65 (and now, other modes) used for EME to be the most dramatic example of the power of the WSJT modes, it's probably not the most widely of the WSJT modes in use in Amateur Radio. Weak Signal Propagation Reporter (WSPR) is software and a network of receive stations and beacon transmitters that demonstrate that with sufficiently powerful software, very low power transmissions can be received around the world. How low power? How about software running on a Raspberry Pi modulating one of the General Purpose Input Output (GPIO) pins? While it does work to connect the GPIO pin directly to an antenna, that "raw" signal includes a lot of undesirable artifacts. This very modest kit from TAPR slightly amplifies and filters the transmitted signal, and provides a real antenna connector.

Amateur Radio is amazing!

QSO Today Virtual Ham Expo - 2021-08-14 and 15

See Zero Retries Issue 0001 for my first batch of events in 2H 2021 that may be of interest to Zero Retries Readers.

2021-08-14 and 15 - QSO Today Virtual Ham Expo - I didn't see too many presentations of interest in the first version of this event earlier this year, but this coming event features a number of interesting presentations such as:

- A next generation beacon network to promote VHF/UHF propagation studies - Hans van de Groenendaal ZS6AKV
- Adventures with Repeater Builder - Michelle Thompson W5NYV
- Design your own communication protocols - Brian Callahan AD2BA
- Beacon in LEO - Vidya Gopalakrishnan K4VGK
- TAPR TangerineSDR update - Scotty Cowling WA2DFI
- and many more! (I posted a complete list of the presentations I'm most interested in an article on my SuperPacket.org blog - QSO Today Virtual Ham Expo.

I plan to attend this virtual event.

Editorial comment - In my opinion, given the quality and breadth of presentations, and that "exhibiting" is virtual (no travel expenses), if you're a vendor selling to Amateur Radio Operators, you'd be foolish to skip this opportunity to showcase your products.

Request To Send

With this fourth issue of Zero Retries, it feels safe to call Zero Retries a weekly newsletter. Writing for publication once per week now feels sustainable. Especially now that I have a feel for how much content Substack is going to allow me to put into each issue. When the little orange icon (**Nearing email length limit!**) starts appearing in the lower left corner of the Substack editor screen, that particular issue is pretty well complete, and the next article I intended to write gets pushed into the next issue.

I have a profound story about launching Zero Retries that I suppose can now be told. In the years I've been imagining Zero Retries, creating it had always felt like a solid goal in my mind, and I felt like I was steadily working towards launching Zero Retries "soon". I had written ample content, but there were always more things on the to-do list that "should get done before I launch".

Sometime this past June, I casually read an article by Kevin Kelly called 99 Additional Bits of Unsolicited Advice. I'm confident you'll find much wisdom in it, as I did. But as I read through the various bits of unsolicited advice, this one "bit" was *really* profound:

If your goal does not have a schedule, it is a dream.

There are moments when you encounter things that sear your soul, and that one seemingly innocuous bit of unsolicited advice seared mine. Just copying and pasting it into this story, it still leaps out at me. The moment I read it, it was instantly clear to me that I hadn't yet launched Zero Retries because ***I didn't have a schedule*****!** I had not *committed* to actually *launching* Zero Retries. You're reading Zero Retries now because in that moment, I realized that I *really didn't want Zero Retries to be merely a dream*. With a quick glance at the calendar, I decided to launch Zero Retries, ready or not, on Friday, July 2nd, 2021 at 15:30 Pacific. For some very good reasons that aren't germane here, I just couldn't make that date, and quickly recommitted to launch Issue 0000 exactly one week later on Friday, July 9th, 2021 at 15:30 Pacific. Thank you Kevin Kelly! I *really* needed that one particular bit of unsolicited advice.

There's a *funny* story about why Zero Retries publishes every Friday at 15:30 Pacific. It involves **Zero Retries Instigator-In-Chief** Bill Vodall W7NWP. W7NWP was always generous with feedback from his perspective as a potential reader with deep interest in my intended subject matter. One of his primary pieces of feedback was a story of how much he looked forward to another "newsletter" by our mutual friend, and hero of all techies in the 1980s, Steven K. Roberts N4RVE. Per W7NWP, every Friday afternoon or evening, N4RVE would send out an update to his very large email list about his activities of the previous week. W7NWP's feedback was that he *really looked forward to reading that email* ***every*** *Friday!*

Over the years I've been working on Zero Retries, I bent W7NWP's ears the worst, and bent his ears more often than anyone else's. I figure I owe him for all those years of patient listening (with only occasional outbursts of frustration) as I prattled on about Zero Retries. So, solely to give W7NWP an interesting email to read on Friday afternoons, I decided that Zero Retries will auto-publish every Friday at 15:30 Pacific.

In my article in Zero Retries Issue 0002 - Packet Radio Hardware in 2021, I kind-of "dissed" hardware Terminal Node Controllers (TNCs). Make no mistake, I'm a fan of TNCs… but now only in a nostalgic sense. I have *many* TNCs in my equipment stacks, and I hope to put at least some of them back on the air in some way… if only to shoot packets around my shop at very low power to be able to show off what "we could do, back in the day". One TNC project I will definitely do is get a TAPR TNC-2 on the air on 145.01 MHz, using a period-appropriate radio, to at least periodically beacon.

In another sense, we now have "modern" TNCs, as in dedicated appliances connected to a radio - we just don't call them a TNC any more. The Nexus DR-X and DRAWS that I referenced are the modern equivalent of TNCs - they just use more powerful processors (Raspberry Pi vs an 8-bit processor), software (such as Dire Wolf vs fixed firmware) and a high resolution audio interface vs a fixed function modem. Just in time for trying to get folks under forty interested in Amateur Radio Data communications, these "**Data Appliance for Radios (DRAs)**" have modern interfaces. (If you haven't previously heard of DRAs, don't worry - I just created that acronym because using TNC in reference to more modern systems would just cause further confusion).

Instead of having to deal with TNC interfaces such as the vagaries of RS-232 ports, dumb terminal emulators, and obscure command line interfaces, DRAs offer HDMI for a dedicated

monitor, USB ports, and Ethernet, Wi-Fi and even Bluetooth for connectivity to other computers. Best of all, if you prefer not to connect keyboard, mouse, and video to your DRA, you can just set up remote access to your DRA and operate more comfortably from your primary computer, including a laptop. Not only can you use the DRA's desktop, but you can also run applications on your primary computer and couple the input and output to applications running on the DRA because increasingly, applications use TCP/IP sockets to communicate. Thus, instead of just using 127.0.0.1 (localhost), specify the respective IP address of the DRA and the primary computer to communicate between the two applications your local area network, whether it be Wi-Fi or Ethernet.

I certainly wasn't dissing *Packet Radio* technology, techniques, and systems in general. I think there's still a bright future for Packet Radio. In short, it's useful and it has its use cases. That's why I highlighted the Dire Wolf Software TNC, and I'll write future articles about other Packet Radio systems that are part of the future of Amateur Radio Data Communications that I'm seeing emerge.

de N8GNJ

Errata

In Zero Retries Issue 0002, in **Packet Radio Hardware In 2021**, in describing the Nexus DR-X, I said:
DRAWS has a hardware PTT circuit that's supported in the Nexus DR-X software image.
That should have read
***Nexus DR-X** has a hardware PTT circuit that's supported in the Nexus DR-X software image*.
My thanks for Chris Doutre KC9AD for spotting this error.

Feedback Loop

Bill Dornbush AA6BD

> In [Zero Retries Issue 0002] in the section on Packet Radio Hardware in 2021, you noted for several devices that they have "very useful features such the ability to use two radios." I have been learning about and experimenting with packet radio, and have tried the DRA-30, Signalink, TinyTrak 4, TNC-Pi, and TNC-Pi96K (not a fan, it is too sensitive to use). But I have no idea why using two radios is useful. Perhaps you could explain this, and the other features you referred to. I expect we can all understand the value of the 12v input, but why a GPS and analog inputs are useful is not obvious to me. I could guess but perhaps you could explain this to me and others. Thanks for the great newsletter. I look forward to future issues.

Thanks for writing Bill! The ability to use two radios on a single system is useful for having access to a system from two different frequencies. For example, a Bulletin Board System with access on 144 MHz (1200 bps) and 440 (9600 bps). Another example is a Winlink RMS station with access on HF and VHF.

In truth, given that all of the good CODEC chips are stereo input and output, the second radio port essentially doesn't cost anything but a second connector and perhaps a second transistor for PTT. So, dual radio capability that can be added inexpensively becomes “a feature”.

The DRAWS analog inputs are useful, for example, monitoring battery voltage of the backup battery when the DRAWS is at a remote location. Perhaps even monitoring Received Signal Strength Indicator (RSSI) for radios that have that output.

Disclaimer - This is from memory of watching the discussion on NWDR’s DRAWS and UDRC Support Mailing List. I may not have the details correct. The built-in GPS feature of the DRAWS was the subject of some debate during the development of the DRAWS on Northwest Digital Radio’s (NWDR) support mailing list. A number of early users of the UDRC (predecessor of the DRAWS) used it for operating data modes in the field (camping, hiking, etc.), and chafed at manually having to set the date, time, and position for modes like WISPR and FT8 that required accurate time, date, and position. During the design phase of DRAWS, NWDR was eventually persuaded to put a GPS onboard. With the assumption that every DRAWS would have a GPS, this allowed software that ran on DRAWS to (reasonably) assume that time, date, and position would be available. Another reason to put a GPS onboard was to offer the capability of 1 pulse per second (1 pps) timing for some future modes that required precision timing. (1 pps isn’t available from a GPS receiver connected by USB - there’s too much latency.) It was felt that “GPS chips are cheap… ”, and the rest is history. As far as I know, there is no (mainstream) use of the 1 pps capability, and looking at that decision from years later, it may have been better for the few that wanted GPS on their DRAWS to add an inexpensive GPS receiver via USB and forgo the 1pps capability.

Closing The Channel

It’s a privilege bringing Zero Retries to so many readers.

For the immediate future, Zero Retries will remain an experiment in progress. If you have ideas, please email me - steve.stroh@gmail.com. I’m especially interested in content ideas about things that you’d like to see discussed in Zero Retries. If you write me, I may ask if I can quote you (only with your permission) in Zero Retries.

If you’re enjoying Zero Retries, please tell your friends and co-conspirators. For the first “little while” of Zero Retries, I’m not going to make any major publicity pushes; I’m curious to see how word of mouth will work.

Email issues of Zero Retries are “instrumented” by Substack to gather basic statistics about opens, clicking links, etc. There is no “text only, no instrumentation” version of Zero Retries available. I don’t use such information in any way other than some satisfaction that the data shows that people actually do read Zero Retries.

All previous issues of Zero Retries are available without restriction (no paywalls). For some background on Zero Retries, Issue 0000 was The Introduction Issue.

Contributors this issue:

- Bill Vodall W7NWP - Reminder about WB4APR’s extensive web archive.

- Chris Doutre KC9AD - Inspiration for “fsq is a Gateway Drug for Building a Radio Community” article.
- Steve Goldsmith W1HS - Feedback on the description of Mac Ham Radio.

Thanks for reading!
Steve Stroh N8GNJ
Bellingham, Washington, USA
2021-07-30
If you’d like to reuse an article in this issue, for example for club newsletters, just ask.
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Below is a much more complete “footer” that has evolved over 30+ issues of ZR.

Join the *Fun* on Amateur Radio

If you’re not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, here are some pointers:

- **Ham Radio for Dummies** by Ward Silver N0AX is a great overview of Amateur Radio. N0AX is a gifted writer and HRFD is now in its 4th edition.
- My two favorite **YouTube** channels for a good overview of Amateur Radio are AmateurLogic.TV. and Ham Nation (part of Ham Radio Crash Course). These folks just seem to have so much fun!
- Radio Amateur Training Planning and Activities Committee (**RATPAC**) offers weekly presentations on general Amateur Radio topics (Wednesdays) and emergency communications in Amateur Radio (Thursdays).
- Dan Romanchik KB6NU offers a free **No-Nonsense Study Guide** for the Technician test (PDF).
- HamExam.org Amateur Radio Practice Exams offers good **Flash Card and Practice Exams**.
- When you’re ready to take an **Amateur Radio examination** (Tech, General, or Extra), W1MX - The MIT Amateur Radio Society offers remote exams, free for students and youngsters. *There are apparently many other remote exam options*.

Bonus - with an Amateur Radio license, you’ll be more attractive on dates 😀

Closing the Channel

- In its mission to grow Amateur Radio and make it more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no

cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex!

- My ongoing Thanks to Tina Stroh KD7WSF for, well, *everything* and Bill Vodall W7NWP as *Zero Retries Instigator in Chief*.

- My ongoing Thanks to pseudostaffers Dan Romanchik KB6NU and Jeff Davis KE9V for continuing to spot, and write about "Zero Retries Interesting" type items, on their respective blogs, from Amateur Radio and beyond, that I don't spot on my own.

- Southgate Amateur Radio News consistently surfaces "Zero Retries Interesting" stories.

- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

If you see something interesting mentioned in Zero Retries and would like to search all the Zero Retries "Back Issues", that's now easy - just click:

Search Zero Retries

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More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*

- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ (He / Him)
These bits were handcrafted in beautiful Bellingham, Washington, USA

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